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SCREENING OF *BRASSICA* GENOTYPES FOR HIGHER GRAIN YIELD IN SALT-AFFECTED SOILS

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ABSTRACT

Fourteen genotypes of Brassica (*Brassica comprestries* L.) were studied in the Laboratory under different salinity levels (EC=5, 10,15,20,25 d.Sm^{-1}) for preliminary evaluation in respect of germination percentage and relative growth rate. Five genotypes among 14 were selected for yield evaluation in Multilocational trials at five different natural saline areas of Punjab province. Seed germination ranged form 20-40% at EC=25d.Sm^{-1} Raya Anmol exhibited highest relative growth rate and lowest relative growth rate was exhibited by No. ZBJ. 97003. The stability analysis of seed yield of *Brassica* genotypes collected from different Multilocational trials indicated that high yielding genotypes Khanpur Raya (880 $Kgha^{-1}$) showed its suitability for rich environment due to having regression coefficient significantly different from one. However, the second high yielding genotype RL-18 (729 $Kgha^{-1}$) which had non significant regression coefficient value and non significant value of standard deviation to regression showed more stability and hence it may be grown safely with more economic benefits on saline soils.

Key-words: *Brassica* genotype, saline soil, yield, Lahore, Punjab.

INTRODUCTION

The excessive accumulation of salts in soils of arid and semiarid regions is one of the major constraints to achieve potential yield of agriculture crops. At present the area under salinity is 6.2 million/ha which comes about 30% of the total cultivated area in the country. So it is essentially required to either evolve or select salt tolerant material or to reclaim the land by the other possible and available scientific measures. Edible oil is the major constituent of our daily diet for which Pakistan is chronically deficient. The country production of edible oil is hardly meeting 30% of our requirements.

Oil seed crops are cultivated in Pakistan on more than 0.5 million hectares arable land and their total production is about 0.38 million ton per annum. Most of these oil seeds crops belong to the genus *Brassica* which are widely grown in many countries. More important thing is that area under these species is increasing at a high rate in Pakistan especially in Punjab in most cases on marginal land and these species are being seen as a potential oilseed crop of the country. (Rana *et al.*, 1988).

Brassica species are severely affected by high levels of salts in the growth medium (Mehmood 1988) observed that growth of Raya (*B.juncea*) was greatly inhibited by high concentration of exchangeable Na in the soil. Ashraf and Mc Neilly (1990) reported considerable amount of inter-specific variation for salt tolerance in the genus. Keeping this in view Laboratory as well as field experiments were laid out to study the effects of salts on different *Brassica* spp. and to isolate tolerant genotypes for high yield and better adaptiveness in salt-affected lands.

MATERIALS AND METHODS

Laboratory study

Fourteen *Brassica compestris* genotypes received from Director Oil Seed ARRI, Faisalabad viz. Raya Anmol, ZBJ.97003, ZBJ.96006, 94003, 94001, 87002-1-1, 98009, 98011, 98016, Peela Raya, DGL, Khanpur Raya, RL-18 and Raya 2000 were grown in Petri dishes at six different salinity levels (EC=0,5,10,15,20,25 d.Sm^{-1}). After one week, the seedlings were counted for taking germination data. These 14 genotypes were tested in gravel culture separately against Na^+, K^+, and K-Na ratio and for studying relative growth rate by using the following formula.

$RGR = 1/W \times \delta w/\delta t\ gg^{-1}\ day^{-1}$

W = Dry weight of shoot of the initial harvest

δw = Dry weight of shoot at final harvest – dry weight of shoot at initial harvest

δt = Number of days between initial harvest and final harvest viz., Khanpur Raya, RL 18, Peela Raya, Raya 2000.

Field study

Five genotypes were finally tested at five different salt affected conditions in Faisalabad, Toba Tek Singh, Shorkot and Jhang during the year 2004-05. The seed yield data at maturity were collected and subjected to analysis

of variances (Steel and Torrie 1980) and stability analysis was performed by following Eberhart and Russell model (1966).

RESULTS AND DISCUSSION

A- Effect of salinity on seed germination of different Brassica cultivars

Seed germination of *Brassica* cultivars viz. Raya Anmol, ZBJ-97003, ZBJ-96006, ZBJ-94003, ZBJ-94001, ZBJ-87002-1-1, ZBJ-98009, ZBJ-98011, ZBJ-98016, Peela Raya, DGL, Khanpur Raya, RL-18 and Raya 2000 was tested in Petri dishes at EC=5, 10, 15, 20, 25dSm^{-1} along with control (Table 1). Seed germination was little affected up to salinity level of EC=15dSm^{-1}. There after, it progressively decreased. Seed germination ranged between 20-40 percent at EC= 25dSm^{-1}. The cultivars differed among themselves at EC=15, 20 and 25dSm^{-1}. The notable exceptions were Raya Anmol, ZBJ-97003, ZBJ-96006 and Peela Raya. Seed germination in these cultivars were less affected than other varieties at various levels and it ranged between 38-40% even at EC = 25 dSm^{-1}. In contrast all other cultivars have 20 or higher percent seed germination at EC=25 dSm^{-1}.

EFFECT OF SALINITY ON SEEDLING STAGE

Brassica cultivars viz Raya Anmol, ZBJ-97003, ZBJ-96006, ZBJ-94003, ZBJ-94001, ZBJ-87002-1-1, ZBJ-98009, ZBJ-98011, ZBJ-98016, Peela Raya, DGL, Khanpur Raya, RL-18 and Raya 2000 were tested in gravel culture (Table 2). Results indicated that Raya Anmol produced highest relative growth rate (RGR) i.e. 0.19 gg^{-1} day^{-1} and lowest relative growth rate (RGR) was produced by No.ZBJ.97003 which was 0.075 gg^{-1} day^{-1}. Mean K-Na ratio showed that RL-18 gave the lowest ratio (0.625) and was graded as tolerant whereas Raya-2000 was graded as sensitive which produced (1.579) ratio.

Stability parameters

Combined analysis of variance showed high significant variance in varieties, environments and varieties x environments interaction (Table-3). This variation in varieties is an indication that they possessed different genetic background. Significant variation in respect of environment showed different types of environmental conditions prevailed during the growth and developmental stages of the experiments. The significant difference in the V x E may be either crossover nature or non crossover type. In a non crossover G x E interaction, in which case the ranking of genotypes remains constant across environments and the interaction is significant because of changes in the magnitude of response (Baker 1988, Blum 1983, Matus *et al* 1997). In crossover G x E interaction, a significant change in rank occurs from one environment to another (Matus *et al*1997). Genotypes differ significantly in their mean yield performance. The G x E interaction of genotypes in this study was of non crossover nature.

Table 1. Effect of salinity on seed germination percentage of different *Brassica* cultivars.

Sr. #	Genotype	Control	EC=5	EC=10	EC=15	EC=20	EC=25
1	Raya Anmol	100	95	90	85	70	40
2	ZBJ-97003	100	90	88	70	50	39
3	ZBJ-96006	100	95	85	65	50	38
4	ZBJ-94003	100	90	80	65	45	25
5	ZBJ-94001	100	90	80	65	40	20
6	ZBJ-87002-1-1	100	90	75	60	35	20
7	ZBJ-98009	100	96	85	75	60	25
8	ZBJ-98011	100	95	85	75	65	30
9	ZBJ-98016	100	95	85	60	40	25
10	Peela Raya	100	95	85	60	65	40
11	DGL	100	95	90	70	55	35
12	Khanpur Raya	100	95	85	70	55	25
13	RL-18	100	95	90	60	40	25
14	Raya 2000	100	95	85	45	35	20

Table 2. Salinity Means of Na^+, K^+ and K-Na Ratio and Relative Growth Rate (RGR) In Brassica Cultivars Grown Under Salinized Culture Solution.

Sr. #	Genotype	Na^+ dSm^{-1}	K^+ dSm^{-1}	K-Na (Ratio)	RGR
1	ZBJ-97003	0.410199	0.645084	1.572612	0.075
2	Raya- Anmol	0.396687	0.385655	0.97219	0.19
3	ZBJ-96006	0.416796	0.33069	0.793411	0.183333
4	ZBJ-94003	0.400697	0.464191	1.158459	0.121667
5	ZBJ-94001	0.358136	0.390659	1.090812	0.1
6	ZBJ-87002-1-1	0.404192	0.33757	0.835171	0.1625
7	ZBJ-98009	0.398812	0.51249	1.28504	0.115
8	ZBJ-98011	0.426274	0.317004	0.743663	0.163333
9	ZBJ-98016	0.457524	0.253502	0.554075	0.15
10	Peela Raya	0.504789	0.548936	1.087455	0.0925
11	D.G.L	0.349093	0.529273	1.516137	0.1025
12	Khanpur Raya	0.49838	0.352705	0.707702	0.13
13	R.L-18	0.563138	0.352446	0.62586	0.111667
14	Raya-2000	0.376903	0.595344	1.579566	0.103333

In case of analysis of variance (Table-4) varieties, showed highly significant differences. Varieties x environments interaction (Lin) was also significant. While nonlinear (Pooled deviation) interaction was non significant. Higher and significant values of G x E Linear interaction as compared to nonlinear are suggested the possibility of prediction of performance for seed yield over the environments. Higher values of the linear component as compared to nonlinear one has also been reported by (Khan *et al* (1987), Jindal *et al* (1985, Jain *et al* (1984), and Yadav and Tomar (1985).

Overall in respect of seed yield performance of brassica genotypes, genotype Khanpur Raya produced significantly the highest seed yield (880 $Kgha^{-1}$) followed by RL -18 (729 $Kgha^{-1}$) and DGL (658 $Kgha^{-1}$), as compared to 666 $Kgha^{-1}$ of standard mean (Table-5). Khanpur Raya and Raya 2000 had regression coefficient values significantly different from unity while genotypes RL-18, DGL, and Peela Raya showed non significant differences from one in case of regression coefficient (bi). All the genotypes showed non significant differences to zero regarding standard deviation to regression (S^2d).

Table 3. Combined analysis of variance for *Brassica* genotypes seed yield (2004-05).

Sr. #	Genotype	Mean Seed Yield Ton/ha	Regression Co-efficient (bi)	Standard deviation to regression (Sd^2)	
1	Khanpur Raya	0.880 A	1.557 *	0.000	
2	RL-18	0.729 B	1.100 NS	0.000	
3	DGL	0.658 C	0.982 NS	0.001	NS From zero
4	Peela Raya	0.569 D	0.861 NS	0.000	
5	Raya-2000	0.496 E	0.501 *	0.000	
Mean		0.6664			

Finlay and Wilkinson (1963) computed for each variety a linear regression of its yield on the mean yield of all the varieties for each location. Accordingly, a stable variety is the one for which the regression coefficient does not differ from zero. In Eberhart and Russell model (1966), regression coefficient is considered as parameter of response and standard deviation to regression (S^2d) as the parameter of stability. High value of regression coefficient (bi) indicates that variety is more responsive and hence can be recommended for highly favourable environments, say under high fertility conditions. A relatively lower value of (bi) say around one will mean, less responsive to the environmental changes and therefore, more adaptive. If however bi is negative, the variety may be grown only in poor environment. S^2d if significant form zero, will invalidate the linear prediction. If S^2d is non significant the performance of a genotype for a given set of environment may be predicted. If a variety had S^2d value not significantly different from zero it is said to be stable one. In this study the high yielding genotype, Khanpur Raya

showed its suitability for rich environment due to having regression coefficient significantly different from one. However, genotype RL-18 with 729 Kgha^{-1} seed yield non significant regression coefficient value and non significant value of standard deviation to regression showed more stability and hence it may be grown safely with more economic benefits on saline soils such that studied in this set of experiments. Stability analysis have also been carried out in many field crops such as barley (Voltas *et al* 1999), Bermuda grass (Chakroun *et al* 1990), oilseed rape (Brandle and Mcvetty 1988) and lentil (Sarwar *et al* 2003).

Table 4. Pooled analysis of variance for *Brassica* genotypes.

Source	Df	S.S	M.S	F. Value
Total	24	0.507	0.021	
Environments	4	0.054	0.013	
Varieties	4	0.440	0.110	228.534 **
Varieties x Environment	16	0.014	0.000	
Environment + Varieties x Environment	20	0.067	0.003	
Environment (Lin)	1	0.054	0.054	
Varieties x Environment (Lin)	4	0.006	0.002	3.287 *
Pooled Deviation	15	0.007	0.000	1.002 NS
Pooled Error	50	0.024	0.000	

Table 5. Stability Parameters of Seed Yield of *Brassica* Genotypes for the Year 2004-05.

Sr. #	Genotype	Mean Seed Yield Kgha^{-1}	Regression Co-efficient (bi)	Standard deviation to regression (S^2d)
1	Khanpur Raya	880 A	1.556 *	217.115 NS
2	RL-18	729 B	1.105 NS	691.833 NS
3	DGL	658 C	0.984 NS	1169.801 NS
4	Peela Raya	569 D	0.856 NS	161.334 NS
5	Raya-2000	496 E	0.998 *	169.922 NS
Standard Mean		666		

Table 6. Seed yield kgha $^{-1}$ of *Brassica* Genotypes in Saline Environments in Multilocational yield Trials during the year 2004-05.

Sr. #	Genotype	1	2	3	4	5
1	Khanpur Raya	998 A	925 A	852 A	831 A	793 A
2	RL-18	833 B	730 B	708 B	694 B	678 B
3	DGL	703 C	700 C	654 C	674 C	559 C
4	Peela Raya	624 D	608 D	557 D	540 D	515 D
5	Raya-2000	535 E	506 E	472 E	503 E	465 E

CONCLUSION

Brassica genotypes collected from different Multilocational trials indicated that high yielding genotypes Khanpur Raya (880 Kgha^{-1}) showed its suitability for rich environment due to having regression coefficient significantly different from one. However, the second high yielding genotype RL-18 (729 Kgha^{-1}) which had non significant regression coefficient value and non significant value of standard deviation to regression showed more stability and hence it may be grown safely with more economic benefits on saline soils. By growing RL-18 in saline soils the income of the poor farmers can be increased and oil seed production will be boosted up in the country.

REFERENCE

Ashraf, M. and T. Mc Neilly (1990). Responses of four Brassica species to sodium chloride. *Env. Exp. Bot*., 30: 475-487

Baker, R.J. (1988). Test for crossover genotype – environmental interaction. *Can.J.Plant Sci*., 68: 405-410.

Blum, A. (1983). Genetic and physiological relationship in plant breeding for drought resistant. In: *plant production and management under drought condition* (J. T. Stone and W. O. Wills eds). Elsevier, Amsterdam.PP:195-205.

Brandle, J.E. and P.B.E. Mcvetty (1988). Genotype x environment interaction stability analysis of seed yield of oil seed rape grown in Manitoba. *Can. J. Plant Sci*., 68: 381-388.

Chakroum, M., C.M. Taliaferro and R.W. Mc New (1990). Genotype-environment interaction of Bermuda grass forage yields. *Crop Sci*., 30:49-53.

Eberhart, S. and W.A.Russel (1966). Stability parameters for comparing varieties. *Crop Sci*., 6: 36-40.

Finlay, W. and G.N.Wilkinson (1963). The analysis of adaptation in a plant breeding programme. *Aust.J.Agric.Res*., 14: 742-754.

Jain, K.C., B.P. Pandya and K. Pande (1984). Stability of yield components chickpea genotypes. *Ind. J. Genet*., 44: 159-163.

Jindal, L.N., T.H. Singh, A. Rang and M.L.Bansal (1985). Stability for seed yield and its components in coriander. *Ind. J. Genet*., 45: 358-361.

Khan, I.A., B.A. Malik and M. Tahir (1987). Phenotypic stability for yield in chickpea. *Pak. J. Sci. Ind. Res*., 309:455-456.

Matus, A., A.E. Slinkard and C.V. Kessel (1997). Genotype x environment interaction for carbon isotope discrimination in spring wheat. *Crop Sci*., 37: 97-102.

Mehmood, S. (1988). *Responses of 4 Brassica species to salinity, drought and water logging*. M.Sc. Thesis Bahauddin Zakariya University, Multan, Pakistan.

Rana, M.A. A.R. Khan and M. Munir (1988). *Oil seed crops in Pakistan, Status, constraints and strategy*. Pakistan Agriculture Research council Islamabad, Pakistan.

Sarwar, G., M. S. Sadiq, M. Saleem and G.Abbas (2003). Genotype x environment interaction in newly developed lentil germplasm under cotton based cropping system. Proceedings of seminar: 17-19, 2002 held at NARC, PARC, Islamabad, Pakistan. Sustainable utilization of plant genetic resources for agriculture production: 219-226.

Steel, R.G.D. and J.H.Torrie (1980). *Principles and Procedures of Statistics*. Mc Graw Hill Book Company, Inc. New York.

Voltas, J., I. Romugosa, A. Lafarga, A. Parmesto, A. Samero and J.L. Aruns (1999). Genotype by environmental interaction for grain yield and carbon isotope discrimination of barley in Mediterranean Spain. *Aust.J.Agric. Res*., 50: 1263-1271

Yadav, I.S. and P.S.Tomar (1985). Protein content and its stability in blackgram. *Ind. J. Agric. Sci*., 55:510-512.

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